Ne-21 in the etched pyroxene residue, a new method is developed. The total neon, obtained in the step-wise heating of etched Kapoeta pyroxenes, is assumed to be a mixture of SF + GCR + SCR neon components. Taking the GCR exposure of the dark portion to be the same as that of the light portion (i.e. 2.5 m.y.), we subtract the GCR-Ne equivalent from the observed total Ne value. The resulting neon comprises of SCR and SF components. These ratios, when plotted in the three isotope neon diagram, permits a graphical resolution of these two neon components by the lever-rule method.

For Kapoeta pyroxenes, we used a GCR exposure age of 2.5 m.y. (Goswami and Nishiizumi, 1981) and subtracted the pyroxene equivalent GCR spallation from the total observed Ne. The corrected Ne ratios are 20/22 = 8.25 and 21/22 = 0.266. We find that the average shielding depth for SCR irradiation is ~ 0.4 g cm^{-2} and the ratio of SF Ne-21 to GCR Ne-21 to be ~ 20 after correcting for the percentage of irradiated grains in Kapoeta. If we use a SCR proton flux about 400 times the average value of the present Sun, the SCR irradiation of Kapoeta grains works out to be a million years or so, which is consistent with the average residence times of the grains on asteroidal regoliths.

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Cr ISOTOPIC ABUNDANCES

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We have developed techniques for the chemical separation and isotopic analysis of Cr in silicates and spinels. The purpose is to pursue the evidence for correlated isotopic effects in Ca-Al-rich inclusions (CAI) for elements in the vicinity of the Fe-abundance peak. Such a correlation is most striking for Ca and Ti for the FUN inclusions EK-1-4-1 and C-1 (Lee *et al.*, 1978; Niederer *et al.*, 1980). Measurements of Ti in non-FUN inclusions (Niederer *et al.*, 1980, 1985; Niemeyer and Lugmair, 1981) have established the presence of endemic isotopic effects in ^{50}Ti and the presence of distinct effects in ^{47,49}Ti in some inclusions. Birck and Allègre (1984) have presented Cr data on four CAI. Using a normalization to ^{50}Cr/^{52}Cr, they reported normal ^{53}Cr/^{52}Cr and distinct effects in ^{54}Cr/^{52}Cr which range up to +8 ϵu. For two of the inclusions with ^{54}Cr/^{52}Cr effects they also reported excesses in ^{50}Ti. These workers reported normal Cr for total samples of Allende, Tatahouine and Juvinas. We report Cr isotope abundances in samples of carbonaceous meteorites and in one CAI. Analyses of terrestrial Cr show typical precision better than 1 ϵu for ^{53}Cr/^{52}Cr and ^{54}Cr/^{52}Cr. Cr was loaded on Re + Re powder as the nitrate, converted to Cr_2O_3 and measured as Cr^+. Interferences from Ti^+ and V^+ were negligible; Fe^+ and CaO^+ were monitored at mass 56 and found to be less than 20 ppm of ^{54}Cr. No effects due to hydrocarbons were identified. For Egg-6 we have determined a distinct excess at ^{54}Cr/^{52}Cr of 6.3 ± 1.2 ϵu in the spinel. A deficit in ^{53}Cr/^{52}Cr of -1.0 ± 0.6 ϵu is considered possible but not clearly resolved. The effects seen in Egg-6 are comparable to the effects reported by Birck and Allègre (1984) and we consider them as confirming their reported isotopic patterns for anomalous Cr in CAI. Our measurement in the spinel is of the same magnitude as their effects. This shows that spinel is not a carrier of much larger effects than are present in the silicates. The total meteorites show no nonlinear effects in either ^{53}Cr/^{52}Cr on ^{54}Cr/^{52}Cr to better than 1 ϵu. This is in contrast to Ti which shows distinct excesses at ^{50}Ti (Niemeyer and Lugmair, 1984; Niederer *et al.*, 1985; Kastenmayer *et al.*, 1985a, 1985b). This demonstrates that effects in ^{50}Ti in whole meteorites are not associated with Cr effects. For the normalization to ^{50}Cr/^{52}Cr the nonlinear effects in Cr for the Allende inclusions appear as excesses in ^{54}Cr/^{52}Cr and possible deficits in ^{53}Cr/^{52}Cr. The excesses in ^{54}Cr can be inter-

preted as supportive of the general evidence for components in CAI of products of neutron-rich equilibrium nucleosynthesis (cf. Niederer *et al.*, 1980, 1985).

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Table 1

	Cr[a]		Ti[b]
Sample	**ϵ(53/52)**	**ϵ(54/52)**	**ϵ(50/48)**
Allende Egg-6 (sp)	-1.0 ± 0.6	6.3 ± 1.2	4.4 ± 1.2
Total Meteorites			
Allende [CV3]	-0.5 ± 1.1	0.9 ± 1.3	1.4 ± 1.1
	0.4 ± 0.6	0.1 ± 0.9	
	0.7 ± 0.6	1.1 ± 0.9	
Murchison [CM2]	0.7 ± 1.0	1.6 ± 1.3	4.7 ± 0.9
Adelaide [anom.]	-0.7 ± 1.3	-2.0 ± 1.6	5.1 ± 1.3
Terr. Normal	0.6 ± 0.4	0.3 ± 0.9	
	-0.2 ± 0.9	-1.4 ± 2.3	
	0.2 ± 0.9	0.9 ± 1.2	
	0.2 ± 0.6	-0.1 ± 1.1	
	0.2 ± 0.7	0.9 ± 1.1	

[a]Cr ratios have been corrected for isotope fractionation using the exponential law and assuming $^{50}Cr/^{52}Cr = 0.051859$ (Shields *et al.*, 1966). ϵ values for $^{53,54}Cr/^{52}Cr$ are deviations, in parts in 10^4, from the values $^{53}Cr/^{52}Cr = 0.113447$ and $^{54}Cr/^{52}Cr = 0.0282092$ for the terrestrial normal, as determined in this laboratory. Cr concentrations: 1500 ppm Egg-6 spinel; ~ 2500 ppm in total meteorites (by atomic absorption).
[b]Data from Niederer *et al.* (1985).

REFRACTORY INCLUSIONS IN THE EFREMOVKA METEORITE AND A COMPARISON WITH OTHER CARBONACEOUS CHONDRITES

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Two surfaces of a small slab of the Efremovka (C3V) carbonaceous chondrite (~ 380 mm^2 of surface area) were surveyed in order to determine the characteristics of Ca-Al-rich inclusions (CAIs) and to compare them to other carbonaceous chondrites. Several inclusions on one side of this slab have been previously studied (inclusion E13 of Ulyanov *et al.*, 1982; Nazarov *et al.*, 1982). This sample of Efremovka contains ~ 9 vol.% CAIs compared to previously reported values of 3.5-3.7 vol.% (Ulyanov *et al.*, 1982; McSween, 1977). This variation suggests that the meteorite may be quite heterogeneous on a small scale, possibly related to its distinctly oriented fabric, with an apparent concentration of CAIs into one layer.